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Original Article

Milk Composition, Hygiene Practices and Marketing System in Wachale District, North Shewa, Ethiopia

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ABSTRACT

This study assessed the raw cow milk chemical composition, hygienic practices, and marketing system in the supply chain of the Wachale district of North Shewa. A structured questionnaire was used to collect primary data from 68 randomly selected dairy farmers, and 60 raw cow milk samples were used for chemical analysis. Out of the total milk produced (14.64±1.10litres/households/day); the highest proportion (13.66±0.99) was sold as raw milk through an informal marketing system with no quality control. And a little proportion (0.54±0.07) was used for human consumption, implying that milk consumption is not a strong habit in the study area. The result also revealed that the chemical compositions of raw cow milk samples collected did not meet the quality standards. Furthermore, raw milk was delivered to the next actors in the open sunshine and roadsides on the ground, which was dusty and not protected from wind and road traffic. The result also demonstrated that the selling prices of raw milk at the farmers' level were very low, forcing producers to adulterate the milk with water and remove fat to compensate for the low price. Due to many constraints, milk production and handling practices in the study area are low and of poor quality, and thus appropriate dairy husbandry and sanitary milk handling practices should be promoted to increase milk productivity and quality in the study area.

Keywords: Milk composition, milk consumption, milk marketing, hygienic practices

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INTRODUCTION

Agriculture is the backbone of Ethiopia's economy, and livestock is an important component of it (Duguma, 2022). With an estimated 70 million cattle, 42.9 million sheep, 52.5 million goats, 2.15 million horses, 10.8 million donkeys, 0.38 million mules, and 8.1 million camels, Ethiopia boasts Africa's biggest livestock population (CSA, 2021). This livestock sector has contributed a significant amount to the country's economy and continues to promise to rally around economic development. For instance, livestock farming contributes about 17%–25.3% of the national gross domestic product (GDP), 39%–49% of agricultural GDP, and over 50% of household income (Shapiro *et al*., 2017; Biratu and Haile, 2017), and 12%–15% of the export earnings, and employs about 60%–70% of the population (Tegegne *et al*., 2013). The GDP of livestock-related activities was valued at birr 59 billion (Metaferia *et al*., 2011). Livestock also contributes food products, draft power, skins, and manure for fuel and fertilizer; and job opportunities (Ahmed *et al*., 2004; Tadesse *et al*., 2017; Duguma, 2022).

As indicated above, Ethiopia also has the largest cattle population in Africa, estimated to be around 70 million head, of which about 97.4% of the total cattle in the country are local breeds (non-descriptive types, which do not belong to any specific breed). The remaining are hybrid and exotic breeds that accounted for about 2.3% and 0.3%, respectively. Dairy cows are estimated to be around 7.55 million and milking cows are about 15 million heads (CSA, 2021). Despite the large cattle population, milk productivity is very low (4.96 billion liters/year with a 1.48-liter average milk yield/cow/day) (CSA, 2021), and the annual per capita milk consumption is very low, estimated at 20L, though rising consumption levels in Addis Ababa (capital city of Ethiopia) have brought it to about 40L (Barry *et al*., 2017). This is much less than the 200 liters of per capita consumption recommended by the World Health Organization (WHO) (Duguma, 2022).

The countries' increasing population, urbanization trend, rising household income, and preferences for animal sources of food are associated with a substantial increase in the demand for, and production of, livestock and livestock products in developing countries (Delgado, 2005; Tsedey and Bereket, 2016).

Eastern Africa is the leading dairy producer in Africa, and approximately 68% of the dairy products of the continent come from Ethiopia, Kenya, and Tanzania (Bingi and Tondel, 2015). It is estimated that the dairy sector contributed 9%–14% of East Africa's agricultural gross development product (Lukuyu *et al*., 2019).

In Ethiopia, dairy production is one of the hoariest and integral components of livestock farming (Azage *et al*., 2013; Tsedey and Bereket, 2016), and is characterized almost all by rural smallholder dairy production using indigenous cattle, and using improved dairy breeds is still at its infant stages. Smallholder farmers are the main and the most important producers of milk with about 97.4% of the country's milk supply.

According to (CSA, 2021), the national average daily milk yield and lactation period of the dairy cow are 1.482 L and 7 months, respectively. This shows low productivity per head of local cows attributed to technical and non-technical constraints; for example, feed shortages in terms of quality and quantity; high disease and parasite incidences, and low genetic potential of the local breed, among others. The smallholder dairy sector contributes to approximately 16.5% of the national GDP, 35.6% of the agricultural GDP, 15% of export earnings, and 30% of agricultural employment (Behnke, 2010; Metaferia *et al*., 2011).

Dairy production is an integral component of livestock farming in Ethiopia (Azage *et al*., 2013; Tsedey, and Bereket, 2016). Ethiopia is endowed with diverse topographic and climatic conditions favorable for dairy cow production that support the use of improved, high milk-yielding dairy breeds, and offer relatively disease-free environments for dairy production (Berhanu, 2012; Mebrate *et al*., 2019). Even though cattle, camels, goats, and sheep are the main livestock species that supply milk in Ethiopia, cattle milk constitutes the larger proportion of the milk produced nationally (83%) (Pongruru and Nagalla, 2016).

As dairying is found to be an important enterprise and has the potential to be economically viable and greatly contribute to poverty alleviation, food security, improved family nutrition, and income and employment generation (Niraj *et al*., 2014; Mebrate *et al*., 2019), promotion of the dairy sector in Ethiopia can therefore contribute significantly to poverty alleviation as well as the availability of food and income generation.

Milk is very important for the nutrition of the young and milk-born biologically active compounds such as casein and whey proteins (Amanuel and Ulfina, 2019), are increasingly important for physiological and biochemical functions that have crucial impacts on human metabolism and health (Gobbetti *et al*., 2002).

Although milk has a high nutritional value, it constitutes a good growth medium for bacteria, of which some are pathogenic to humans (Jayarao and Henning, 2001), unless it is produced and handled under good hygienic conditions (FAO, 2010).

Microorganisms may contaminate milk at various stages including production, procurement, processing, and distribution (O'Connor, 1994; Mitiku *et al*., 2019), which results in milk-borne diseases in humans while others are known to cause milk spoilage. Because of the specific product, it is impossible to avoid contamination of milk with microorganisms (Karmen&Slavica, 2008). Control of animal health, devotion to good milking practices, and control over milking parlous hygiene ((FSA, 2006), are important in enhancing the quality of milk and dairy products produced along the entire dairy supply chain.

A milk marketing study is essential to provide vital and valid information on the operation and efficiency of the milk product marketing system for effective research, planning, and policy formulation (Adebabay, 2009). According to Yilma *et al*.,

(2011), around 95% of the milk marketed in Ethiopia at the national level was reported to be channeled through informal outlets which are characterized by direct delivery of fresh milk to immediate neighborhood consumers without any quality control. The milk marketing system is not well developed giving the large majority of smallholder milk producers limited access to the milk market. Even though many dairy cooperatives are involved in milk production and marketing in the entire nation country, accounting for only 2% of the total number of agro-based cooperatives operating in various parts of the country. In most cases, existing dairy cooperatives are operating in areas that are the potential for milk production, access to transportation, and markets. This means that a substantial amount of milk does not reach the markets and several producers keep on producing at a subsistence level (Zelalem, 2012; Mitiku *et al*., 2019).

In Ethiopia, the government has developed a strategy aimed at increasing the development of dairy production to satisfy the increasing demand for milk and milk products in an area where there is high demand. As a result, the number of urban and peri-urban dairy farmers was increasing in recent decades and gaining importance to benefit from dairy development as a source of family food, income, and employment opportunity (Duguma, 2022).

To this end, the need to understand milk compositions, hygiene practices, and marketing in the supply chain of the Wachale district is crucial. The Wachale district, included in the current study, is a high-potential area for milk production and marketing in the North Shewa zone of Oromia. However, in general, there was no study conducted about milk composition, hygiene practices, or marketing. As a result, any measure towards improving dairy productivity may not be in line with the utilization of the available resources and scarce production inputs. Understanding these issues, therefore, would be useful to develop policies, development strategies, and business development services for the efficient value chain in smallholder milk marketing, which is a one-step forward toward bridging this gap. Therefore, this study was conducted to determine milk chemical composition, hygiene practices, and marketing to suggest possible alternative solutions for improvement in the study area.

MATERIALS AND METHODS

Description of the study area

The present study was carried out in the Wachale district, which is one of the thirteen districts of the North Shewa Zone of Oromia Regional State, Ethiopia. The district is located 78 km northwest of Addis Ababa. It has the geographical location of 9°18'-9°46'N and 38°42'-39°07' E latitudes and longitudes (Figure 1), respectively. The average annual rainfall and temperature of the study area are about 1000mm and 25°C, respectively (GTF, 2020, unpublished). The number of cattle used for milk purposes at North Shoa Zone in 2021 was 116,149 (CSA, 2021). The district has a

total of 139,696 cattle, and 94,141 cattle populations of which 26,142 were cows, 12,193 heifers, and 12,628 female calves, and the remaining 43,178 were male cattle (WDLFRDO, 2021, unpublished).

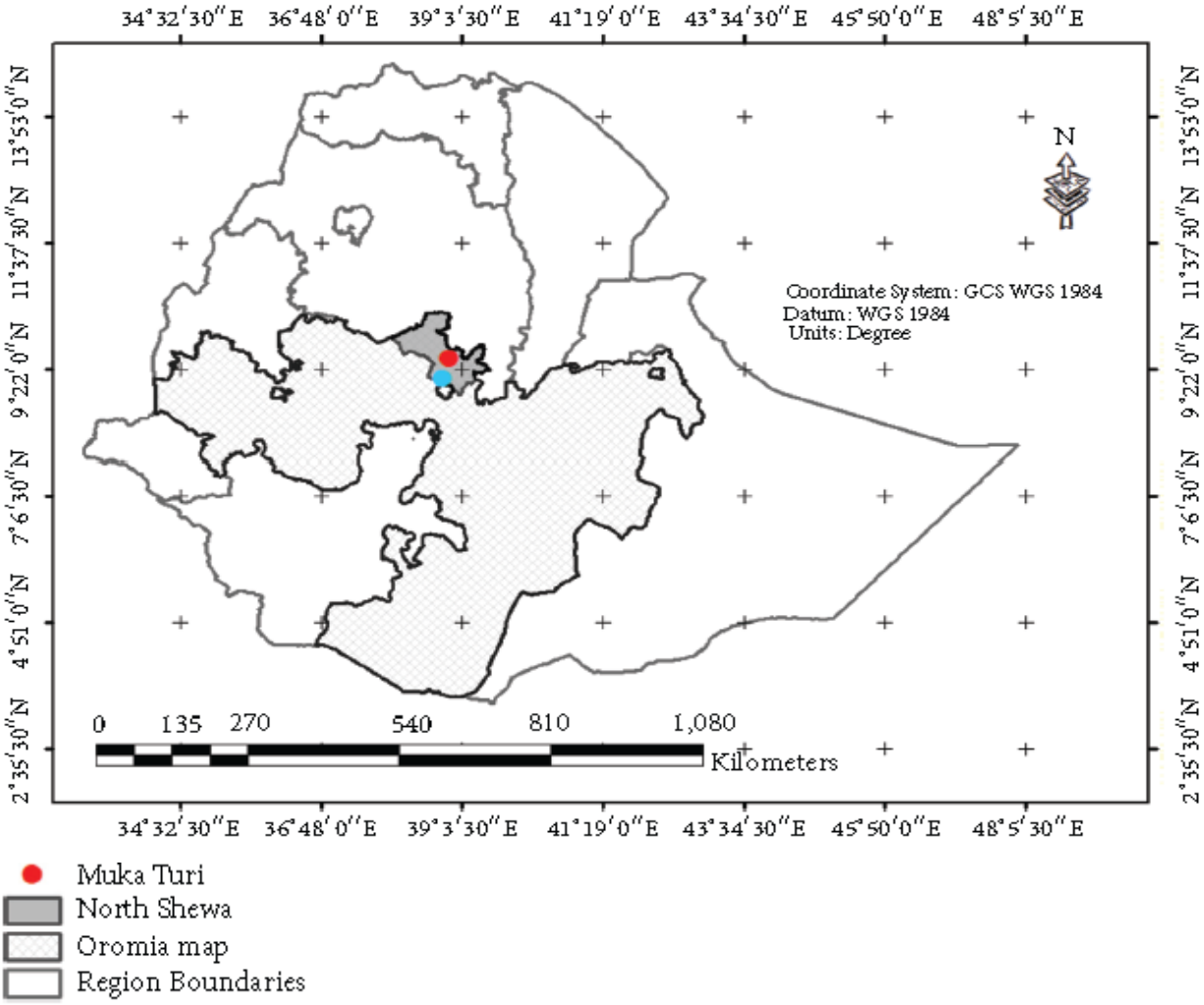

Figure 1: Map of the study area

Study Design and Sampling Procedure

A cross-sectional study design was employed for this study. The Wachale district was chosen for this study because of its milk production and marketing potential, as well as its accessibility. Smallholder farmers with one or more milking cows, and those with previous experience in milk production, were purposefully selected. This study used a two-stage sampling technique. In the first step, the district's Peasants' Associations (PAs) were chosen mostly based on milk production potential and marketing participation. In the second stage, four PAs in the district were randomly selected. Then a total of sixty-eight respondents (twenty-two from each PA) were chosen at random. In addition, sixty raw milk samples were collected from producers, collectors, and whole sellers; twenty milk samples from each milk source in equal

proportion were used for milk chemical composition analysis. Before the interview, selected dairy farmers were briefed on the purpose of the study, assured that their participation was voluntary and confidentiality of all information to be provided, and each respondent verbally gave informed consent to participate in the study.

Data Collection

A standardized questionnaire was used to collect data from a total of 68 smallholder dairy farmers. The survey consisted of open-ended and closed-ended questions. The survey was written in English and then translated and administered in the local language (*Afaan Oromoo*). Then a questionnaire was pre-tested with smallholder dairy farmers who were not included in the final study and an amendment was made. The questionnaire was used to collect information on the demographic characteristics of the respondents, milking and milk handling practices, hygiene of milk marketing places across the milk supply chain, milk handling practices at milk collection centers, milk consumption, and marketing, milk delivery time after milking and milk price, and major constraints of milk production, quality, and marketing in the study area.

Milk Sample Collection and Analysis

Sixty raw cow milk samples were obtained aseptically from producers, collectors, and whole sellers in sterile containers and after complete mixing, as described by O'Connor (1995). A quick milk automatic milk analyzer and a Lactoscan analyzer were used to determine the percentages of fat, lactose, protein, and solid-not-fat in the raw milk samples taken from the three milk sources. The total solids were calculated by adding all of the milk solids together.

Statistical Analysis

The data were coded and analyzed using SPSS version 20.0 (IBM, USA) software. Descriptive statistics, such as means, percentages, and standard error of the means, were used to present the results.

RESULTS AND DISCUSSION

Demographic Characteristics of the Households

The demographic characteristics of the respondents were indicated in Table 1. Female-headed households accounted for more than half (58.8%) of the respondents in the study area, followed by male-headed households (41.2 percent). Across all the sampled households in the respective study area, it was observed that the number of female-headed households exceeded that of males. This suggests that females were mostly responsible for dairy operations in the study area. The findings of this study contradicted those of Habtamu and Tesfaye (2020), who reported that dairy

production was dominated (62.2 percent) by male-headed households in the Nekemte milk shed of Ethiopia.

Regarding the age category, of the milk producers that were interviewed, 35.3% and 55.9%fall within the age group of 20- 30 and 31- 50 years, respectively. This implies that the majority of the respondents were of potentially productive age. This finding is consistent with the findings of Sema *et al*., (2019), who found that 60.5 percent of milk consumers and 47.1 percent of milking persons in Mukaturi and Sululta Towns, Oromia Region, are between the ages of 21 and 30.

Education is perceived as one of the prerequisites for the development of market-oriented dairy farming and understanding the determinants of market channel choices among smallholder dairy farmers (Zewdie, 2010). Regarding the school education category, of the milk consumers that were interviewed, 36.77% are educated while 63.23% (Table 1) had no formal education. Furthermore, 100 percent of respondents said they did not receive regular training on hygienic milk production techniques. The results were similar to those published by Kassahun *et al*., (2014) and Amanuel *et al.,* (2018). Low educational levels may have a direct impact on milk output, quality, and safety.

Table 1: Sex, age, educational level, and family size of the households in the study area

Variables		N = 68	
		Frequency	%
sex	Male	28	41.2
	Female	40	58.8
Age	20-30	24	35.3
	31-50	38	55.9
	51-60	2	2.9
	61-65	2	2.9
	>65	2	2.9
Educational level	Educated	25	36.77
	No formulated	43	63.23
	Primary education	23	33.8
Training on milk hygiene (%) Yes	0	0.0	
No	68	100.0	
Farming system (%)	Livestock only	17	25
	Mixed crop-livestock	51	75
Family Size (Mean ± SE)		6.89 ± 0.30	

N = Number of respondents, SE = Standard Error

The mixed crop-livestock farming system was found to be the major practiced farming system as reported by 75% of the respondents in the study district (Table 1). On the contrary, intensive livestock rearing was the sole farming activity in urban areas, which could be attributed to a shortage of land. Among the livestock species, cattle are

the most important component of the mixed crop-livestock farming system. This research result was slightly in agreement with the report of Alemensh *et al*., (2020).

Milking and Milk Handling Practiced in the Study Area

Milk and milk handling practices in the study area are shown in Table 2. According to this study, hand milking (100%) is the only way of milking in the study area. Hand milking is performed by massaging and pulling down on the teats of the cow. Calves were allowed to suckle their dams before as well as after milking. Similarly, several reports such as Algenash, T. (2002), Tadele *et al.,* (2016), and Tadesse *et al*., (2020) support the result of the current study.

Table 2: Milking hygiene practice during the milking procedure in the study area

Variables		N = 68 Frequency	Percent
Milking method (%)	Hand milking	68	100.00
	Machine milking	0	0.00
Milking frequency (%)	Morning and evening	52	76.47
	Evening only	13	19.11
	Morning only	3	4.41
Utensil used for milking (%)	Wide necked-aluminum can	19	27.94
	Wide-necked plastic can	49	72.05
Cleaning cow's barn before milking	Yes	31	45.58
	No	37	54.41
Wash hand before milking	Yes	65	97.05
	No	3	4.41
Wash udder before milking	Yes	38	55.88
	No	30	44.11
Use of towel while cleaning the udder	Individual towel	8	11.76
	Common towel	19	27.94
	Not at all	41	60.29

Note: N= number of respondents

The majority of milking in the study area was done twice a day, in the morning and evening (76.47 percent) (Table 2). According to Hailemikael *et al*. (2019), the majority of Ethiopian rural households milk their cows twice a day, in the morning and the evening. About 72% of the respondents used a wide-necked plastic vessel for milking, whereas only 27.95% (Table 2) of the respondents used an aluminum milking can. Sema *et al*., (2019) stated that in Selected Dairy Farms in Mukaturi and Sululta Town, Oromia, Ethiopia, the majority of milk customers (72.1 percent) used a plastic container to buy or transport milk. The findings of this study also are in agreement with Teshome *et al*., (2014), *Abunna et al*., (2018), and Alemnesh *et al*. (2020). This

could be because aluminum-made vessels are prohibitively expensive, unaffordable, and scarcely available in local marketplaces for most farmers.

Milking was usually done under poor hygienic conditions where milking rooms were contaminated with cow dung, urine, and various waste items. Moreover, half of the households in the sample (54.41%) did not clean the barn before milking. Dirty cows have a significant impact on total bacteria counts, resulting in poor milk quality, cleaning processes, and human health issues (Amistu *et al*., 2015). In coincide with this finding, Teshome (2014) and Hailemikael *et al.* (2019) reported that milking is done in the shade of grain feed in front of the homestead or under a tree. However, this location is not kept clean save for dung disposal, and milking cows usually get solid with manure pee, and other.

Hygienic practices are important steps in producing safe and high-quality products for consumers, preventing microbial contamination and product loss (FAO, 2009).

About 55.88% of the respondents washed the udder of milking cows before milking; however, 60.29% of these respondents did not use a towel to dry up the udder after washing. Only 27% of respondents used a common towel to dry up their udder after washing. The current study corroborates the findings of Teshome *et al*., (2014) who reported that 71.79% of the household milk producers washed the teats and udder of the cows before milking, but did not use detergents to clean the udder and teats. Furthermore, Alemnesh *et al*., (2020) found that 70-82.5 percent of smallholder farmers in Ethiopia did not use individual towels to dry the udder of the cows.

Hygiene of Milk Marketing Place Across the Milk Supply Chain

According to the findings of this study, all of the observed milk producers, collectors, and transporters in the study area delivered raw milk to the next actors in the open sun and on dusty roadsides that were not sheltered from wind and road traffic. This may be a possible source of microbial contamination of raw milk in the market chain, as the milk was typically exposed to high temperature, road traffic, wind, and dusty conditions for prolonged periods during the process of milk collection, and changing containers and coding.

Similarly, none of the observed milk vendors in the study area have milk preparation and selling areas that are well protected from the sun, dust, wind, road traffic, garbage, and waste. This observation is similar to the finding of Amentie *et al*., (2016), and Abunna *et al*., (2019). According to Ackah *et al*., (2011), food catering places including milk preparation and selling areas should be sheltered (protected) from the sun, dust, wind, road traffic, garbage, and waste, as such areas undoubtedly expose food (like milk) for microbiological contamination. Whenever it is totally difficult to keep clean or protect food preparation and selling areas from contaminant agents (like dust, wind, road traffic, flies, and other contaminant agents), the displayed food

including milk as well as its handling equipment should properly be covered or protected from contamination (Gerald, 2001).

Milk handling Practices at Milk Collection Centers

The containers used for milking, storage/fermentation, and processing are different and diversified in Ethiopia (Lemma, 2004; Alganesh and Yetenayet, 2017). Milk is frequently collected in the morning in the study area for both evening and morning milk. Milk collection in the study area usually takes place in the morning time for both evening and morning milk. Milk was traditionally only sold in the mornings; thus, milk producers kept the evening milk in cold water until the next morning to maintain the temperature lower and minimize microbial proliferation.

About 91.17% of milk was directly collected from dairy producers, while 8.83% of milk collectors bought milk from milk vendors. All dairy farmers deliver milk to the milk collection center by themselves (Table 3). The majority of milk collectors in the study area practiced milk quality tests (Table 3). Lactometer readings and alcohol testing were routine quality assessments in the study area. However, 6.6% of milk vendors did not apply milk quality tests. The major dairy processing plants (100%) such as Lame Dairy PLC (Shola Milk Enterprise), MB PLC (Family Milk), Sebeta Agro-industry (Mama Dairy), and Elemtu Integrated Milk Industry were the formal customers that bought milk from those private milk collectors in the study area. The milk collectors had no customers in Muka Turi town's hotels and restaurants. This research result is in agreement with the report of Alemensh *et al*., (2020).

Table 3: Milk handling practices at collection centers of the study area

Parameters		**N = 68**	
		N	**%**
Source of milk	Farmers	62	91.17
	Milk venders	6	8.83
Mode of delivery	Farmers	68	100
Milk quality test upon delivery	Organoleptic test	27	39.70
	Lactometer and alcohol test	39	57.35
	No test	2	3
Types of clients	Milk processing plant	68	100
	Hotel and restaurant	0	0
Milk transportation utensils	Aluminum cans	13	19.12
	Plastic water bottles	55	80.88
Milk cooling facility	Yes	11	20.16.17
	No	57	83.82

Chemical compositions of Raw Milk in the Study Area

As the results of the study indicated, the mean fat, lactose, Solids-Not fat (SNF), protein, Total Solids (TS), and moisture content of raw cow milk in the study area were 3.28± 0.21, 3.94±.09, 7.24±.0.16, 2.61±0.64, 11.20±0.33, and 14.69±2.28,

respectively (Table 4). These findings disagree with the findings reported by Asaminew (2007), Hirpha *et al*. (2018), and Belay (2022) from different regions of Ethiopia. The minimum fat percent for whole cow milk recommended by the Ethiopian Standards Agency (ESA) should not be less than 3.5% (ESA, 2009). The SNF content of raw milk of cows in the present study is lower than the minimum standard (8.25%) for SNF content of whole cow milk (FDA, 2010). The overall mean protein content of raw milk reported in the current study is slightly lower than the minimum of 3.2% recommended by the ESA (2009).

The low protein content of the milk in the present study could be due to the low protein contents of natural pasture, the major source of dairy cattle feed in the area, and the lack of supplementary feeding with protein-rich concentrates. Generally, milk composition can vary depending on many factors such as breed and the health condition of the animals, lactation period, feeding management (type and quality), season, method of milking (manual or automatic), age, and the number of lactations, individual cows and environmental factors (Pandey and Voskuil, 2011; Wolfson and Sumner, 1993). Respondents used an organoleptic test, Lactometer, and alcohol to evaluate milk quality.

According to the ESA (2009), the minimum fat and protein percentage for whole milk should not be less than 3.5 and 3.2 percent, respectively. Hence, the average fat and protein percent in the current study are slightly below the recommended standard for the nation.

The overall average lactose content in this study showed 3.94 ± 0.92 percent. According to the European Union Quality standards for unprocessed whole milk, the lactose content should not be less than 4.2 percent (Tamime, 2009). The minimum SNF percent set by European Quality Standards for unprocessed whole milk is 8.5 percent (Tamime, 2009). The TS content of milk found in the present study is slightly lower than the minimum standards for TS content of cow milk established by the European Union, which should not be <12.5% (FAO, 2000).

Table 4: Chemical compositions of raw milk of cow in the study area

Chemical compositions	Mean ± SE	Minimum	Maximum
Fat	3.19±0.22	1.10	6.59
Density	25.36±0.58	16.69	29.41
Lactose	3.94±0.92	2.46	4.51
SNF	7.24 ±0.16	4.47	8.21
Protein	2.61±0.64	1.64	3.01
Total Solids	11.20±0.33	7.50	14.00
Moisture	14.69±2.28	2.21	49.00

Abbreviation: *SE*, standard error

Milk Consumption and Marketing

Out of the total milk produced per day (14.64±1.10), the biggest share (13.66±0.99) was supplied to the market, and a little proportion (0.54±0.07) was used for human consumption (Table 5). This implies that there is a weak habit of milk consumption in the study area. Although milk is the primary source of nutrition for children in several parts of Ethiopia, children in the study area consume just a small amount of whole milk. Even though the average per capita/day milk intake was 0.54L, it varied from household to household depending on the amount of milk produced, the number of lactation cows, family size, and the number of small children. Households with large numbers of lactating cows tend to consume more milk compared to those with less number of lactating cows. This study is in agreement with the findings of Abera and Hailemariam (2015) who reported that very limited consumption of fresh whole milk in East Shoa Zone, Ethiopia. Correspondingly, Alemnesh et.al. (2020) reported that out of the total milk produced per day, the biggest share was supplied to the market in the GirarJarso milk supply chain, in Ethiopia. On the other hand, Yilma *et al*., 2011; Tsadkan and Amaniel, 2016; Habtamu and Tesfaye, 2020; Belay (2022) reported that the majority of the milk produced was used for home consumption and that is in the form of fresh whole milk in different areas of the country.

Table 5: Estimate quantity of milk produced, consumed, and marketing in the study area

Variables	Minimum	Maximum	Mean ± SE
Total milk produced/HH/ Day (Liters)	1.5	22.0	14.64±1.10
Total milk processed/HH/ Day (Liters)	1.0	20.0	2.79±0.64
Total milk consumed/HH/ Day (Liters)	0.0	2.0	0.54±0.07
Total milk sold/HH/ Day (Liters)	5.0	30.0	13.66±0.99

Marketing of milk, Delivery Time After Milking, and Milk Price

A market can be visualized as a process in which ownership of goods is transferred from sellers to buyers who may be final consumers or intermediaries (Debrah and Berhanu, 1991). Although it is not the well-developed system, marketing of raw milk was not a major problem for the studied district. This is owing to the proximity of the location to the country's capital city and the presence of multiple milk processing companies in the surrounding areas. This is because; the area is located in the surrounding areas where there are many milk processing plants and due to their proximity to the capital city of the country. The majority of milk producers delivered their milk either to their cooperatives, vendors, or collectors.

All the respondents (100%) indicated that raw milk was sold through informal channels without any quality supervision. It is the direct sale of milk to neighbors (consumers) or retailers and sales to itinerant traders or individuals in nearby towns. The current result is slightly similar to Hailemikae (2019) who reported that 98% of

milk produced in rural areas was sold through informal chains, whereas only 2% of the milk produced reached the final consumers through the formal chains in Ethiopia. On the other hand, different survey reports indicated that selling fresh milk is not common in the central highlands of Ethiopia, eastern Wollega, and eastern Shewa due to inadequate amount of milk produced, cultural restrictions, distance from market areas, and short shelf life of fluid milk (Alganesh, 2002; Lemma, 2004). The informal marketing system is characterized by no licensing requirement to operate, no payment for quality, and fat content. In addition, possibilities for adulteration problems with seasonal fluctuations in production and no public health control.

All dairy producers who sell milk in the study area entered contractual agreements with milk collectors to deliver milk daily and gain the milk price every fortnight. In the study area, the morning milk is collected early in the morning, and the evening milk is collected the next day morning. Like the current study, in some parts of the country such as Holeta, Selale, and Debrebirhan the evening milk is collected the next day morning (Yilma *et al*., 2013).

The average price of milk per liter was 18.32±0.29 Ethiopian Birr at the time of this study. The farmers stated that they received low prices for milk, which is less than the amount of money remunerated for milk production. Milk is sold on a contractual basis and payments are collected mainly at end of a month based on the agreements with customers. The prices of milk vary among the different sources (Table 8).On average the price of milk at smallholder farmers (milk producers), milk collectors, and wholesalers during the study period was 16, 21.5, and 19.5 Ethiopian birrs per liter, respectively. In the study area, milk producers are not satisfied with the current milk selling price; because of this, they are adulterating the milk with water to increase volume and remove the fat thereby fetching equivalent money from the same amount of milk.

Table 6: Milk prices during the study period

Milk source for market	Milk price per litter in ETB		
	Average	Minimum	Maximum
Producers	18.5	17	20
Collectors	18.5	18.5	24
Whole sellers	19.5	18	21

In the study area, in November and December, the milk price was high. This could be related to the high milk demand as the majority of people do not fast during this time, and milk production is relatively low because of the dry season. From January to March, the price of milk reached its lowest level, when the big fasting season in the Ethiopian Orthodox religion falls. Then there was a sharp increment after the big fasting period and during the rainy season (June, July, and August).

Table 7: Major constraints of milk production, quality, and marketing in the study area

Common Problems	Relative degree of importance						
	1st	2nd	3rd	4th	5th	Index	Rank
Lack of technical support	32	45	11	4	0	0.19	2
Absence of functional milk quality control and marketing systems	13	18	38	12	2	0.138	3
Lack of appropriate utensils for milking and milk handling	9	11	14	13	30	0.093	6
Feed problems	61	14	22	3	0	0.216	1
Disease problem	15	8	23	34	1	0.122	5
Lack of adequate market during the fasting season	19	21	24	5	0	0.3	4
Shortage of land, overgrazing, and land degradation	11	11	14	8	28	0.092	7
Shortage of credit service	0	0	0	3	24	0.015	8

Index = Sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for individual reasons divided by the sum of (5*ranked 1st+ 4* ranked 2nd+3* ranked 3rd+2* ranked 4th+1* ranked 5th) for over all reasons.

The result of current result is in agreement with that of Mitiku *et al*., (2019), and Kassahun *et al*., (2014). As it is indicated in many kinds of literature (Sintayehu, 2008, Melesse *et al*., 2014) fasting season is the main challenge for milk marketing and during this time, milk producers sell their milk at relatively lower prices.

Major Constraints of Milk Production, Quality, and Marketing in the study area

The major cause of milk production, marketing, and the quality decrease stated by respondents by ranks were feed problems (1st), lack of technical support (2nd), absence of functional milk quality control and marketing systems (3rd), and others (Table 7).

Although the supply of feed is progressing, the cost of feed is increasing from time to time. Especially, the price of some concentrates such as oil seed cake is highly inflating. The reason for this could the existence of only a few companies that produce limited feed concentrates and fix the price by themselves.

Milk suppliers need to have technical support in the process of production including feeding and nutrition, breeding, sanitation and milk hygiene, human and animal health, marketing, handling, and transportation of milk to collection centers (Samuel *et al*, 2019). The farmers perceived that they received poor extension services regarding dairy management and development. SNV (2008) also reported that livestock extension services are inefficient in the coordination of dairy development activities, controlling livestock diseases, improving forage production, and improving the productivity of the sector. The result also corroborates with Tadesse and Mengistie (2016) and Tadesse *et al*., (2017).

Regarding market-related problems, the majority of the respondents reported inadequate knowledge and awareness of hygienic milk and dairy products handling; absence of functional milk quality control, and marketing systems; shortage of credit service, and lack of appropriate utensils for milking and milk handling. The current result is slightly similar to the findings of Mitiku *et al*., (2019) and (Samuel *et al.*, 2019).

Due to limited financial support, smallholder farmers were not in a position to transform into commercial dairy farming. SNV (2008) and Tadesse and Mengistie (2016) reported there is a lack of credit for the dairy industry.

CONCLUSION AND RECOMMENDATIONS

In the present study, the chemical composition of raw cow milk, hygienic practices, marketing, and related constraint was assessed. The chemical compositions of raw cow milk samples collected were practically below the recommended levels of the Ethiopian Standards Agency (ESA) and FAO quality standards. The majority of the raw milk produced was marketed through an informal marketing system with no quality control. The results of the current study also have demonstrated that the selling prices of raw milk at the farmers' level were very low, and cheaper than alternative

sources, forcing producers to adulterate the milk with water and remove fat to compensate low price. There is a poor and weak habits of milk consumption in the study area. Poor hygienic conditions in the milking environment and milk containers, lack of udder and teat cleaning practices, failure to use a towel for udder washing and drying, and poor personal hygiene of the milkers all contributed to poor and substandard milk and dairy product quality in the study areas, implying the need to improve hygienic practices.

DECLARATIONS

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable

Data availability

Please contact corresponding author for data requests.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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DEDICATION

Ms. Agare Mokenin played a key role in this research. But regrettably, she passed away before the publication of this article. So let this research paper serve as a tribute to her excellent job.

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